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UiO-66-NH_2 MOF/organosilica mixed-matrix membrane for water desalination

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Abstract

Membrane-based technology has aroused great attention in molecules separation and purification process due to the intrinsic advantages (high efficiency, low energy consumption, and easy operation). In the present work, a new amine-functionalized UiO-66/organosilica mixed-matrix membrane was fabricated and explored for pervaporation (PV) water desalination (Figure 1). The incorporation of amine-functionalized UiO-66 (UiO-66-NH_2) into the BTESE-derived organosilica networks endowed the membrane with enhanced hydrophilicity and dense network structure, leading to an improvement in water flux and NaCl rejection. The UiO-66-NH_2/BTESE mixed-matrix membrane was proved to be highly effective for desalination of saline water in concentrations from 1 to 13 wt% of dissolved NaCl. Moreover, the membrane exhibited superior structural stability under a continuous PV desalination operation up to 100 h, delivering water permeance of >3.1 × 10^{-6} mol m^{-2} s^{-1} Pa^{-1} combined with NaCl rejection of >99.9% (Figure 2). The high water permeance was mainly ascribed to the specific pore structure and the preferential interactions between pore channels and water molecules, and the excellent salt rejection was primarily based on the sieving effect. The proposed UiO-66-NH_2/BTESE mixed-matrix membranes show great prospects as an alternative for concentrated brine desalination.

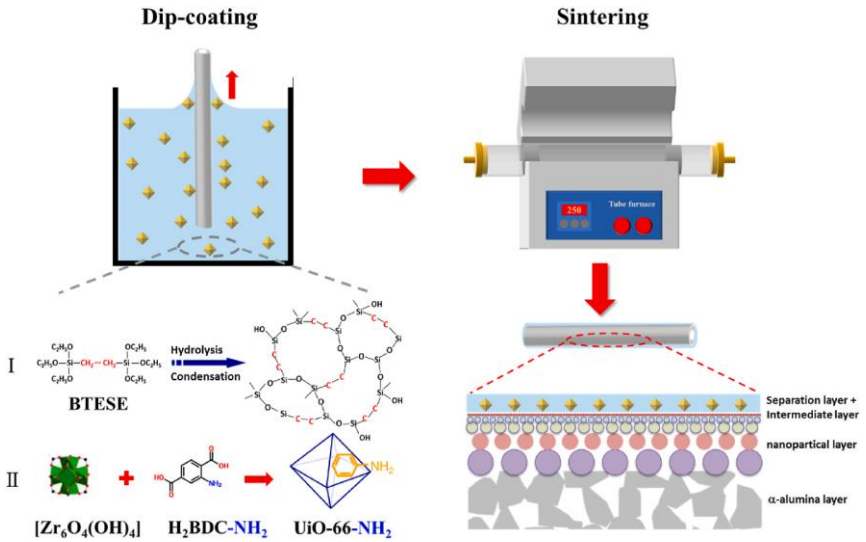

Figure 1. Schematic of fabrication of UiO-66-NH_2/organosilica mixed-matrix membrane.

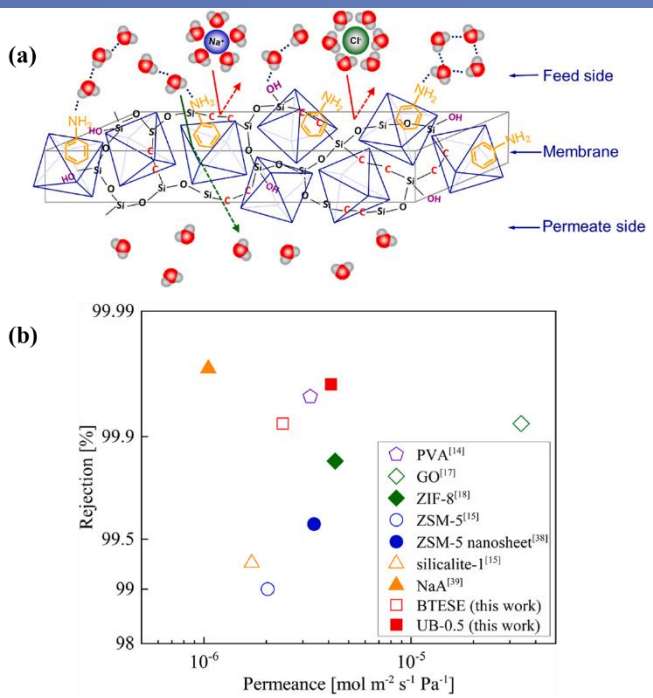

Figure 2. (a) A schematic illustration of water permeation through a UiO-66-NH_2/BTESE mixed-matrix membrane. (b) Comparison of pervaporation performance of some typical desalination membranes (3.5–7.5 wt% NaCl solutions).